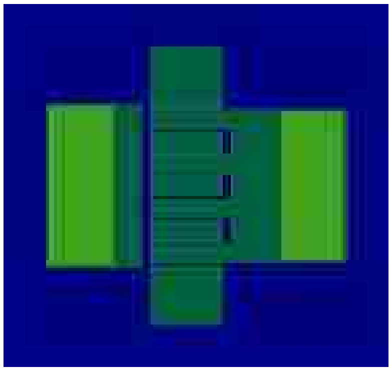
# TGF2941

## DC – 25 GHz, 28 V, 4 W GaN RF Transistor

## Product Overview

The Qorvo TGF2941 is a 4 W ($P_{3dB}$) discrete GaN on SiC HEMT which operates from DC to 25 GHz and 28 V supply. The device is constructed with Qorvo's proven QGaN15 process. The device can support pulsed, CW, and linear operations.

Lead-free and ROHS compliant



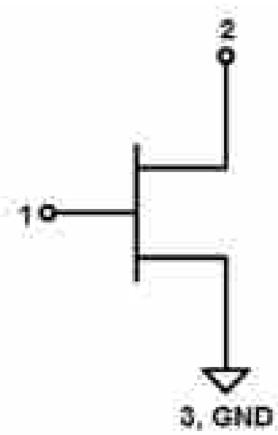
0.521 x 0.551 x 0.100 mm

## Key Features

- Frequency: DC to 25 GHz
- Output Power ($P_{3dB}$)[1]: 4 W
- Linear Gain[1]: 16 dB
- Typical $PAE_{3dB}$[1]: 60%
- Typical Noise Figure[1]: 1.3 dB
- Operating Voltage: 28 V
- CW and Pulse capable
- Non-linear & Noise Models available

Note 1: @ 10 GHz

## Functional Block Diagram




## Applications

- Defense and Aerospace
- Broadband wireless
- Low noise amplifier

## Ordering info

| Part No. | ECCN | Description |
|---|---|---|
| TGF2941 | EAR99 | DC–25 GHz, 28 V, 4 W GaN RF Transistor |

## Absolute Maximum Ratings[1]

| Parameter | Rating | Units |
|---|---|---|
| Breakdown Voltage, $BV_{DG}$ | +60 | V |
| Gate Voltage Range, $V_G$ | -7 to +1.5 | V |
| Drain Current, $I_{DMAX}$ | 1 | A |
| Gate Current Range, $I_G$ | See page 20. | mA |
| Power Dissipation, CW, $P_{DISS}$ | 5.7 | W |
| RF Input Power, CW, 10 GHz, T = 25 °C | +26 | dBm |
| Channel Temperature, $T_{CH}$ | 275 | °C |
| Mounting Temperature (30 Seconds) | 320 | °C |
| Storage Temperature | –65 to +150 | °C |

Notes:
1. Operation of this device outside the parameter ranges given above may cause permanent damage.

## Recommended Operating Conditions[1]

| Parameter | Min | Typ | Max | Units |
|---|---|---|---|---|
| Operating Temp. Range | –40 | +25 | +85 | °C |
| Drain Voltage Range, $V_D$ | +12 | +20 | +29.5 | V |
| Drain Bias Current, $I_{DQ}$ | 20 | 40 | 80 | mA |
| Drain Current, $I_D$ | – | 290 | – | mA |
| Gate Voltage, $V_G$[3] | – | –2.8 | – | V |
| Channel Temperature ($T_{CH}$) | – | – | 250 | °C |
| Power Dissipation, CW ($P_D$)[2] | – | – | 5.1 | W |

Notes:
1. Electrical performance is measured under conditions noted in the electrical specifications table. Specifications are not guaranteed over all recommended operating conditions.
2. Package base at 85 °C
3. To be adjusted to desired $I_{DQ}$

## Model Load Pull Performance – Power Tuned[1]

| Parameter | Typical Values | | | | | | | | Units |
|---|---|---|---|---|---|---|---|---|---|
| Frequency, F | 3 | | 6 | | 10 | | 18 | | GHz |
| Drain Voltage, $V_D$ | 20 | 28 | 20 | 28 | 20 | 28 | 20 | 28 | V |
| Drain Bias Current, $I_{DQ}$ | 40 | 40 | 40 | 40 | 40 | 40 | 40 | 40 | mA |
| Output Power at 3dB compression, $P_{3dB}$ | 35.1 | 36.3 | 35.2 | 36.2 | 35.4 | 36.2 | 35.3 | 36.1 | dBm |
| Power Added Efficiency at 3dB compression, $PAE_{3dB}$ | 61.3 | 59.2 | 60.1 | 58.8 | 56.6 | 58.7 | 44.5 | 52.5 | % |
| Gain at 3dB compression, $G_{3dB}$ | 22.4 | 22.1 | 16.0 | 16.7 | 11.6 | 13.2 | 6.3 | 8.6 | dB |
| Load Reflection Coefficient [(2)], $\Gamma_L$ | 0.20∠90° | 0.28∠45° | 0.32∠108° | 0.41∠76° | 0.50∠127° | 0.63∠108° | 0.64∠141° | 0.78∠130° | -- |

Notes:
1. CW, bondwires not included
2. Characteristic Impedance, Zo = 50 Ω.

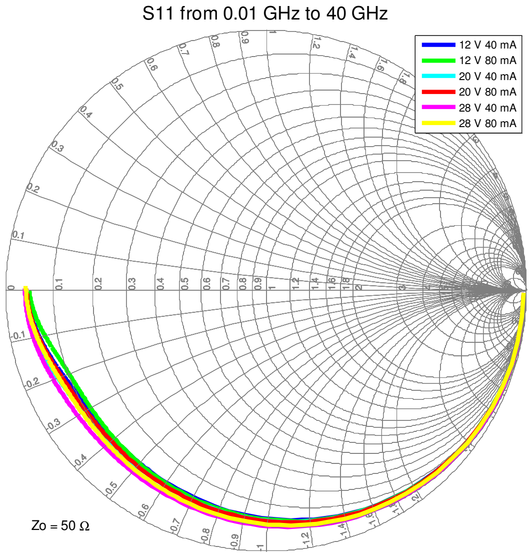
## Model Load Pull Performance – Efficiency Tuned[1]

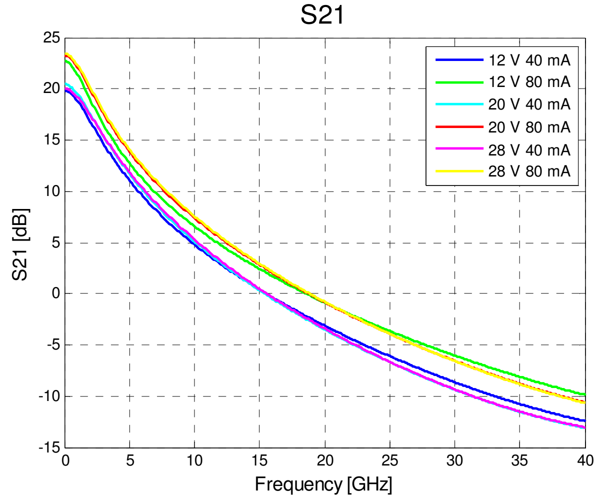
| Parameter | Typical Values | | | | | | | | Units |
|---|---|---|---|---|---|---|---|---|---|
| Frequency, F | 3 | | 6 | | 10 | | 18 | | GHz |
| Drain Voltage, $V_D$ | 20 | 28 | 20 | 28 | 20 | 28 | 20 | 28 | V |
| Drain Bias Current, $I_{DQ}$ | 40 | 40 | 40 | 40 | 40 | 40 | 40 | 40 | mA |
| Output Power at 3dB compression, $P_{3dB}$ | 34.2 | 35.7 | 34.2 | 35.3 | 34.4 | 35.3 | 35.3 | 36.1 | dBm |
| Power Added Efficiency at 3dB compression, $PAE_{3dB}$ | 65.4 | 63.1 | 65 | 62.1 | 63.3 | 60.1 | 53.8 | 52.5 | % |
| Gain at 3dB compression, $G_{3dB}$ | 21.1 | 24.0 | 17.3 | 19.0 | 13.1 | 13.8 | 7.0 | 8.6 | dB |
| Load Reflection Coefficient [(2)], $\Gamma_L$ | 0.36∠56° | 0.50∠53° | 0.50∠90° | 0.61∠81° | 0.67∠117° | 0.73∠106° | 0.78∠140° | 0.78∠130° | -- |

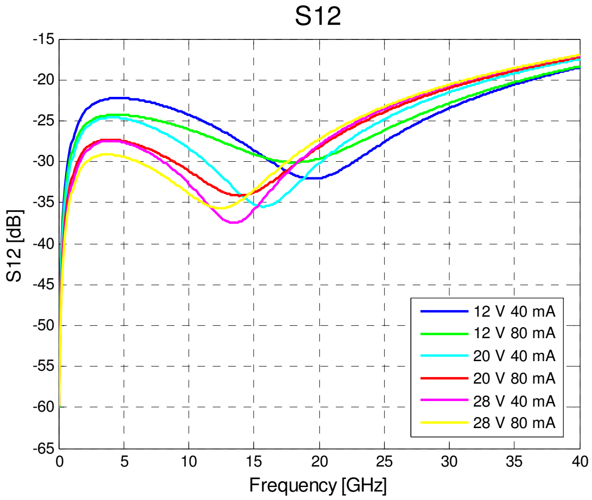
Notes:
1. CW, bondwires not included
2. Characteristic Impedance, Zo = 50 Ω.

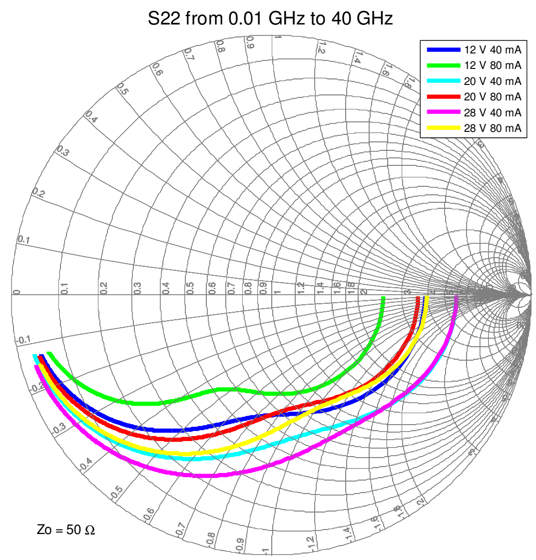
## Model S-parameters[1]

Notes:
1. Bondwires are not included. T = 25 °C.



## Model Maximum Available Gain[1]

Notes:
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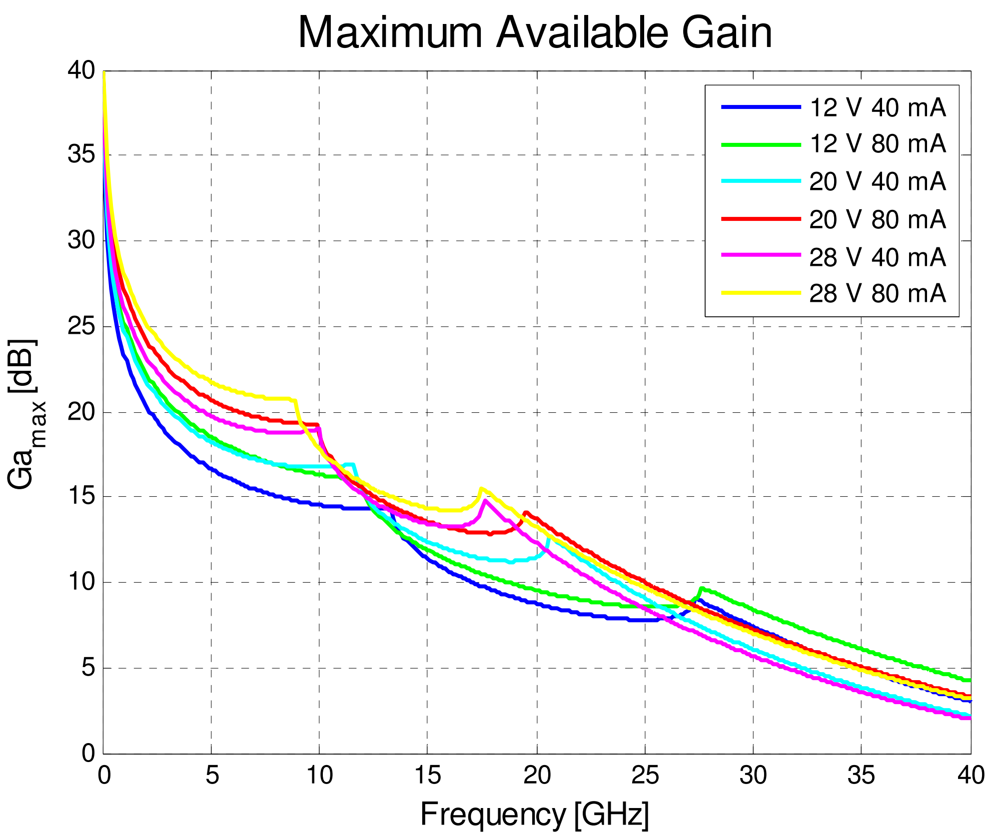
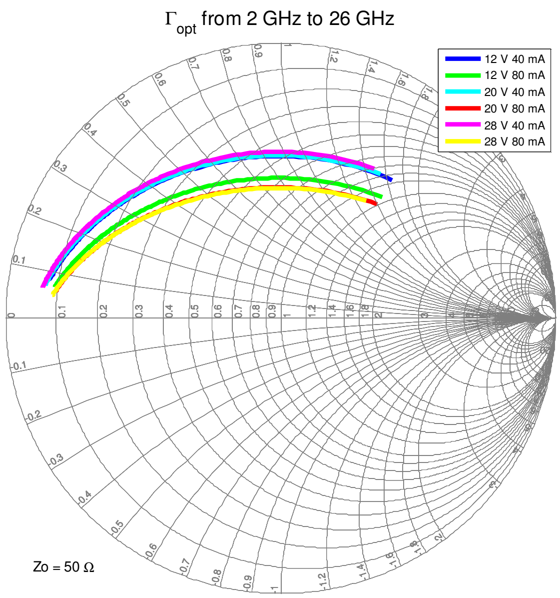
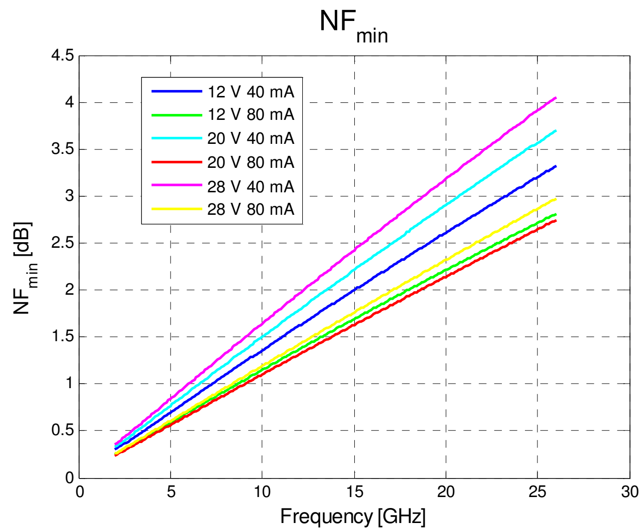
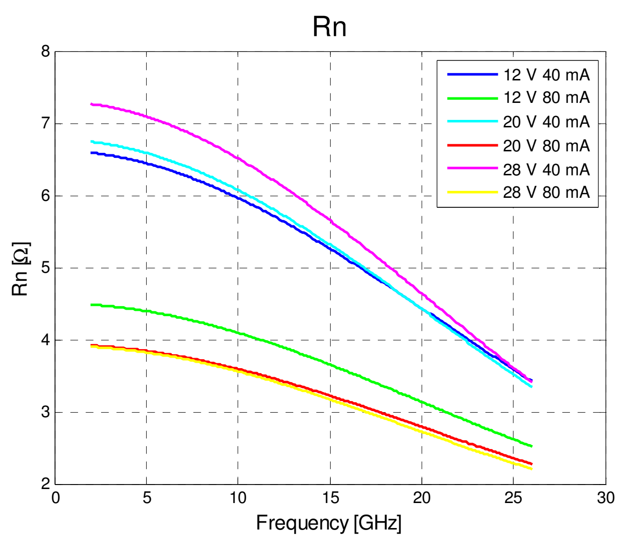


## Model Noise[1]

Notes:
1. Bondwires are not included. T = 25 °C.



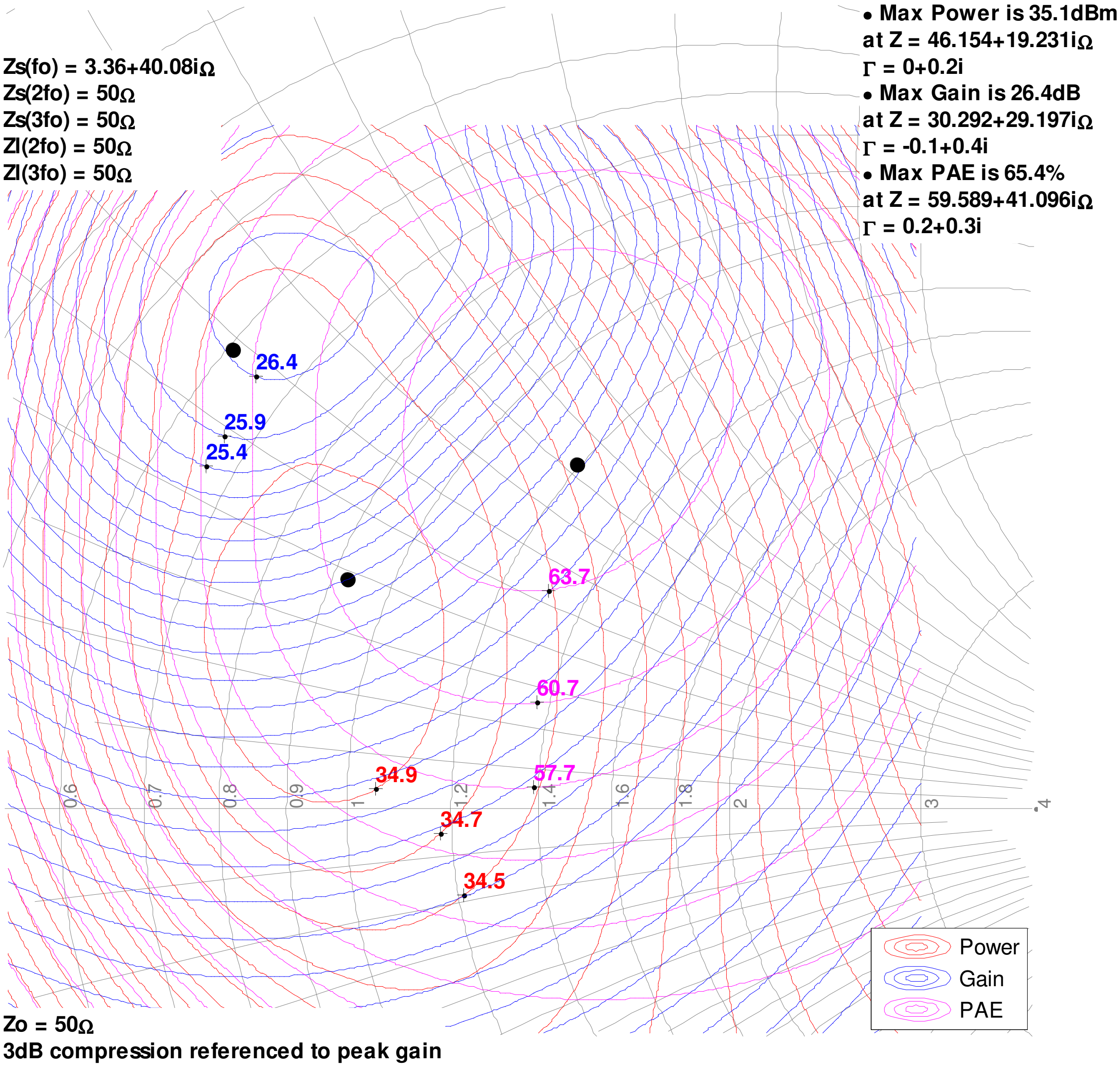



## Model Load-Pull Smith Charts[1, 2]

Notes:
1. Test Conditions: $V_D$ = 20 V, $I_{DQ}$ = 40 mA, CW, Bondwires not included
2. See page 22 for load pull reference planes where the performance was simulated.

3GHz, Load-pull



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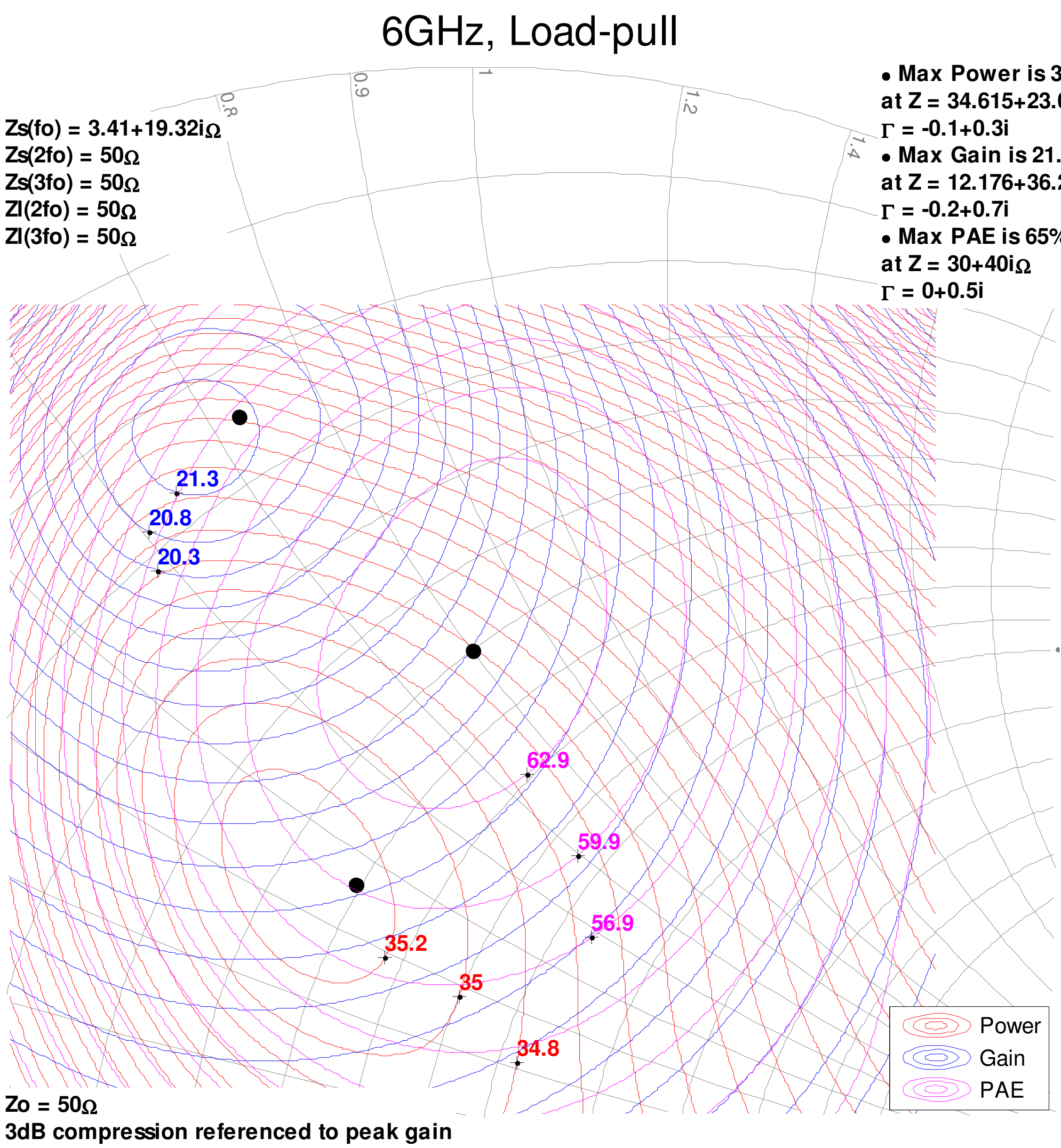

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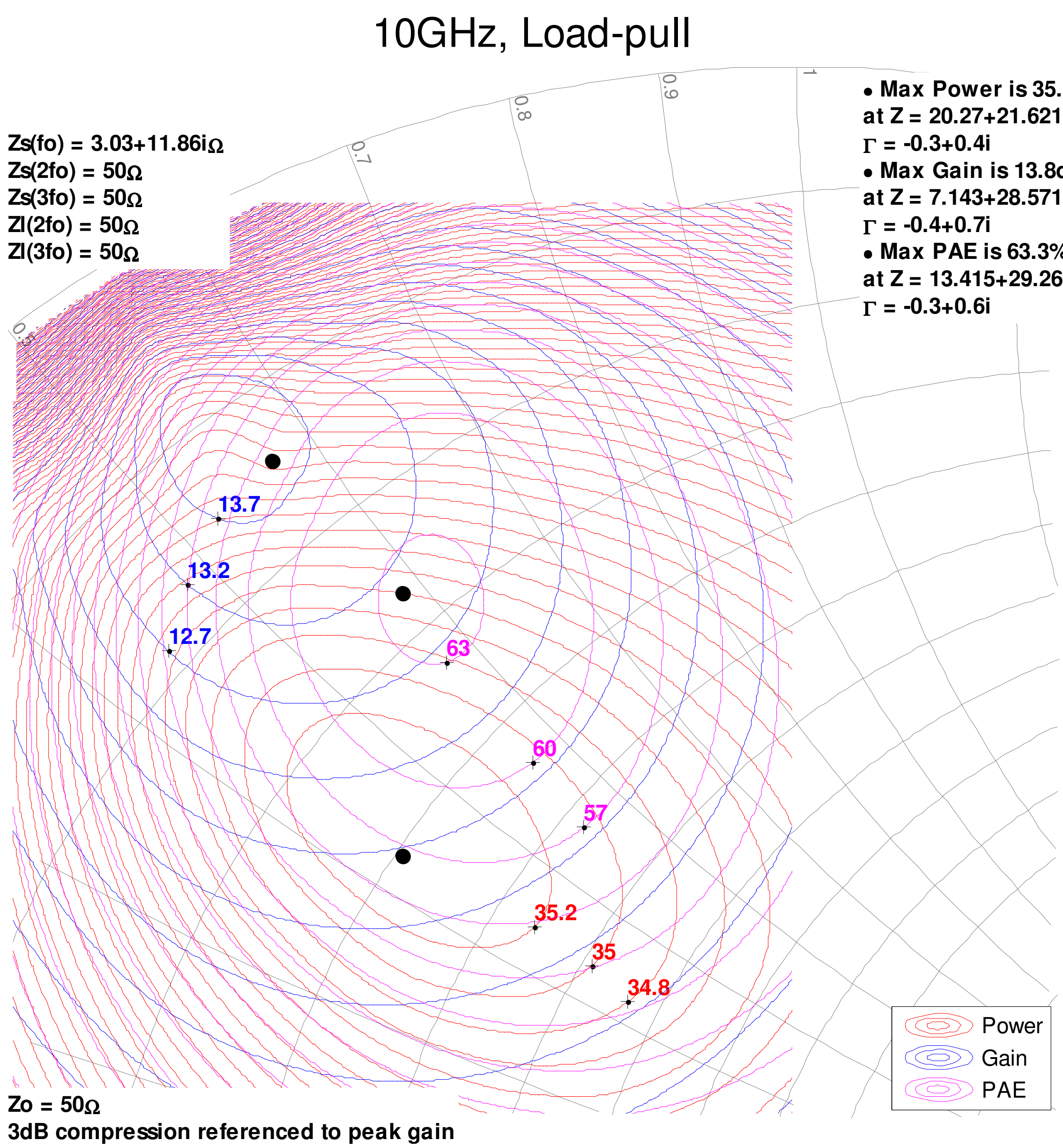

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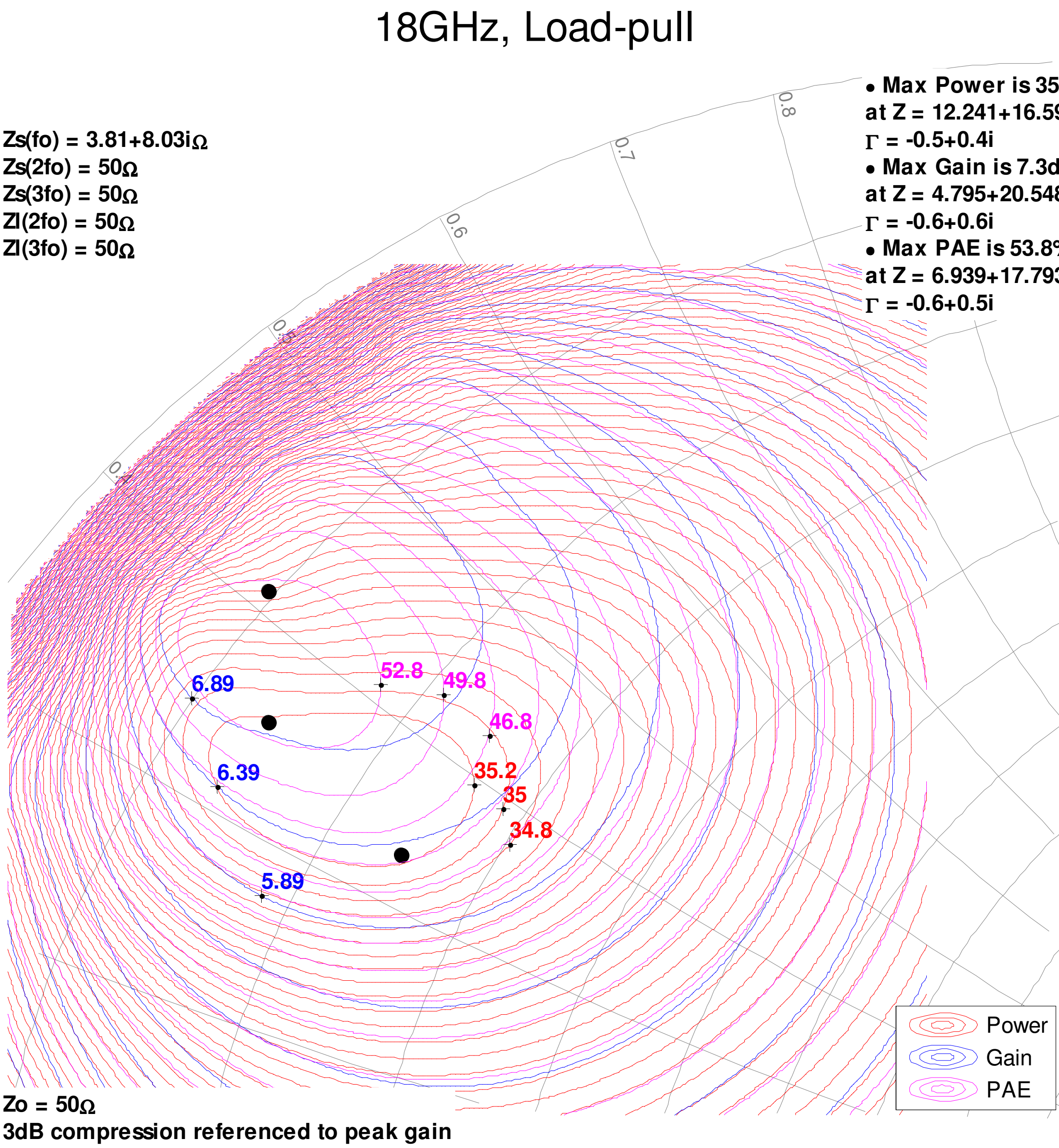
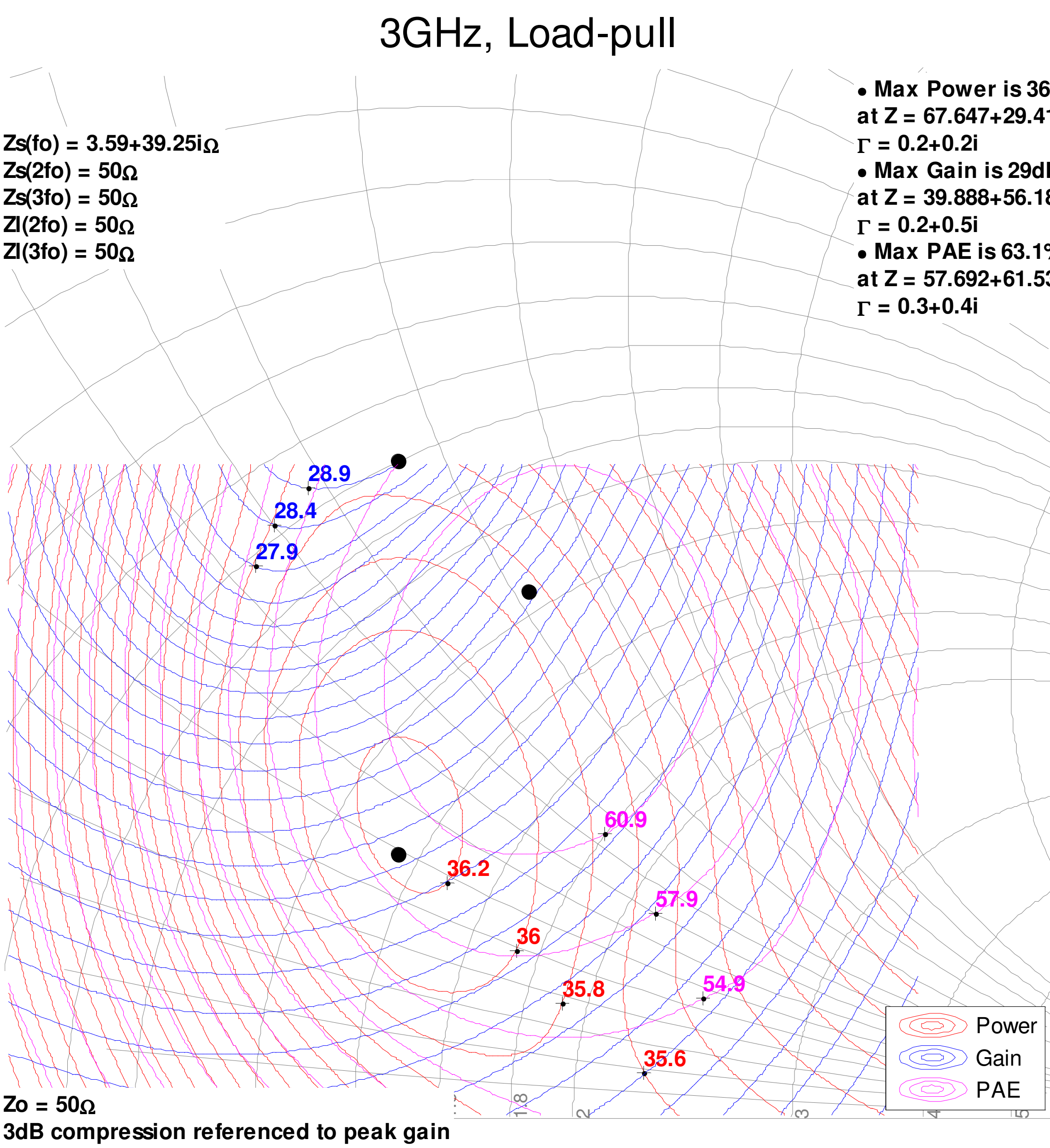


## Model Load-Pull Smith Charts[1, 2]

Notes:
1. Test Conditions: $V_D$ = 28 V, $I_{DQ}$ = 40 mA, CW, Bondwires not included
2. See page 22 for load pull reference planes where the performance was simulated.



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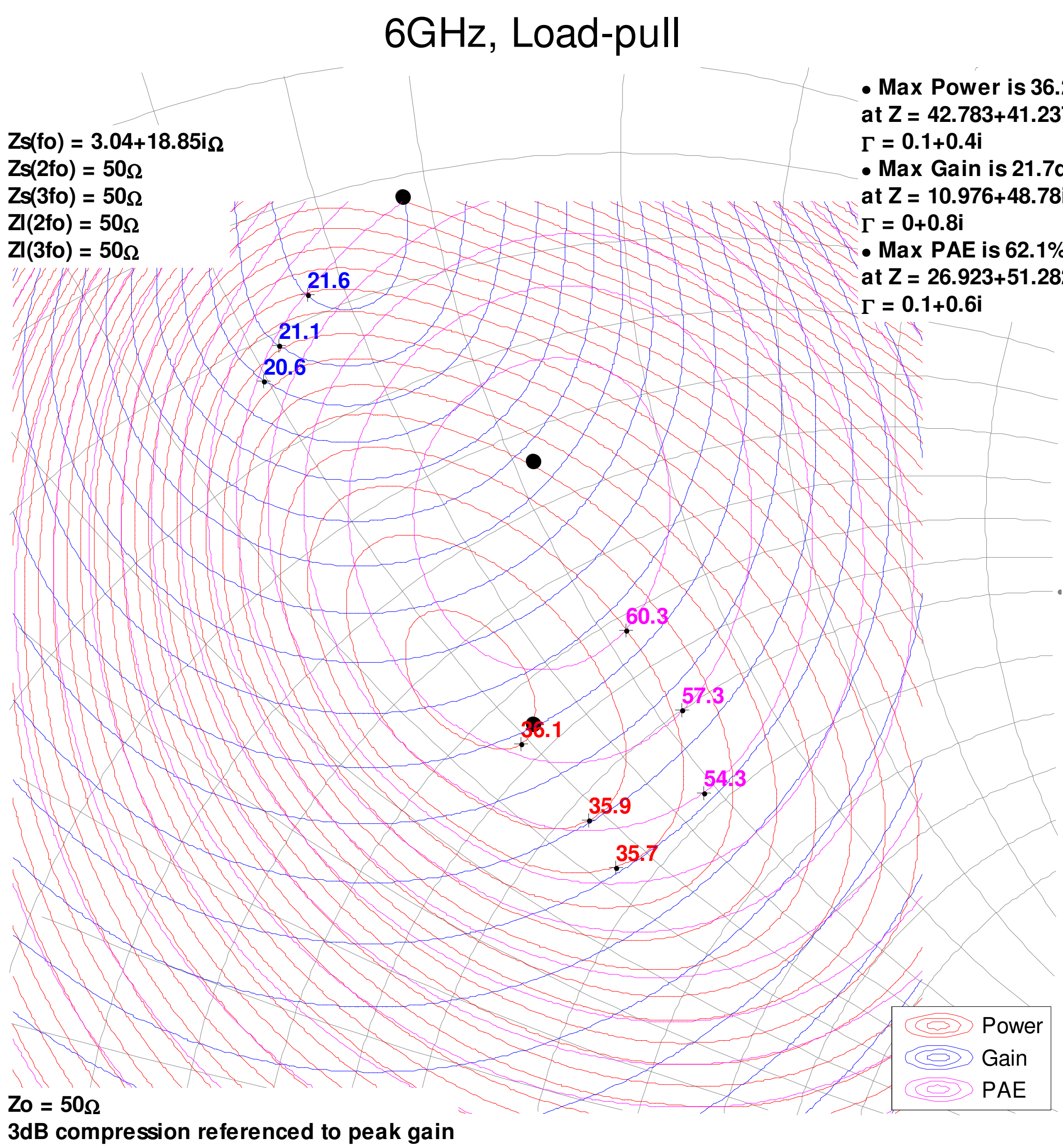

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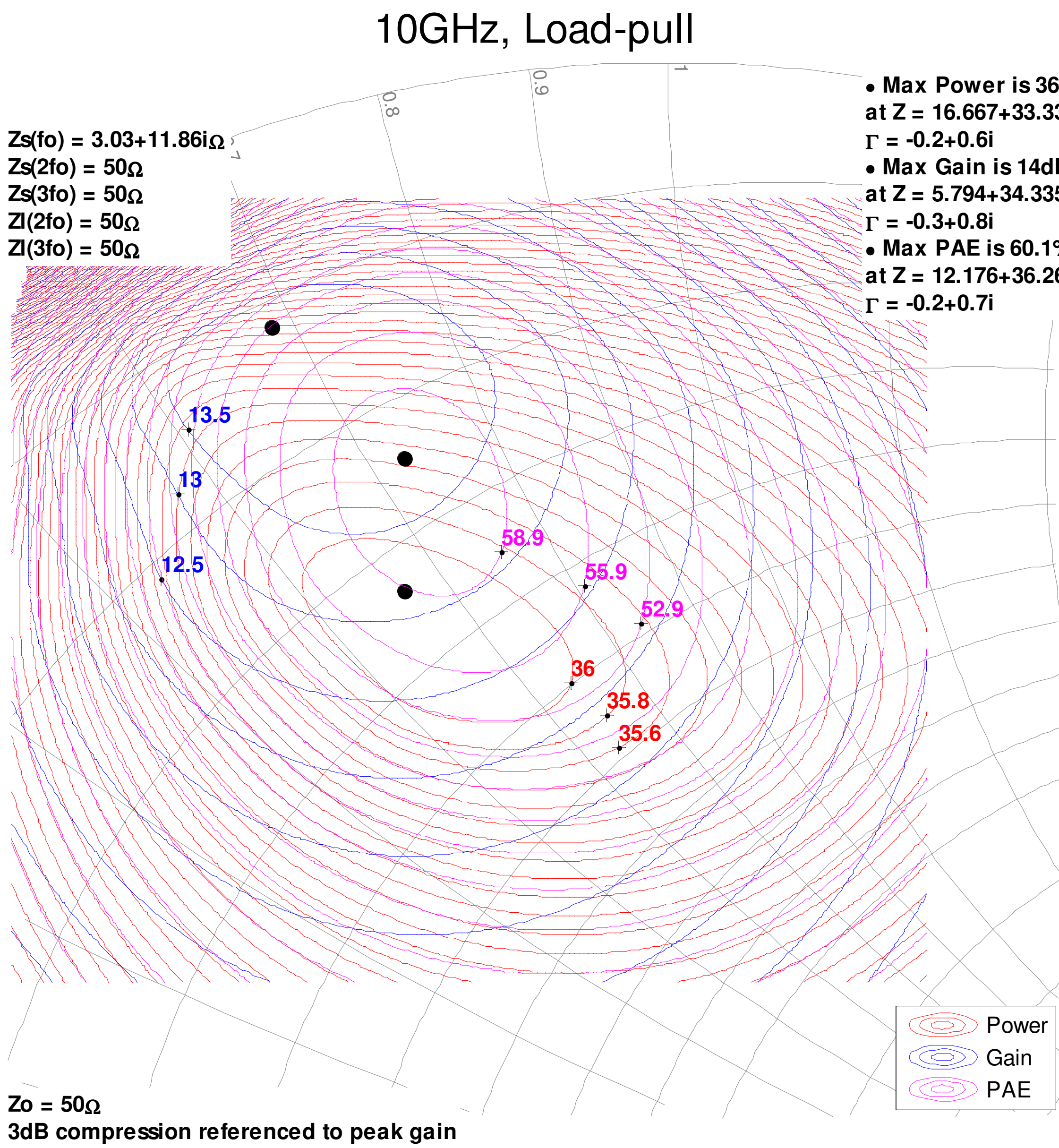

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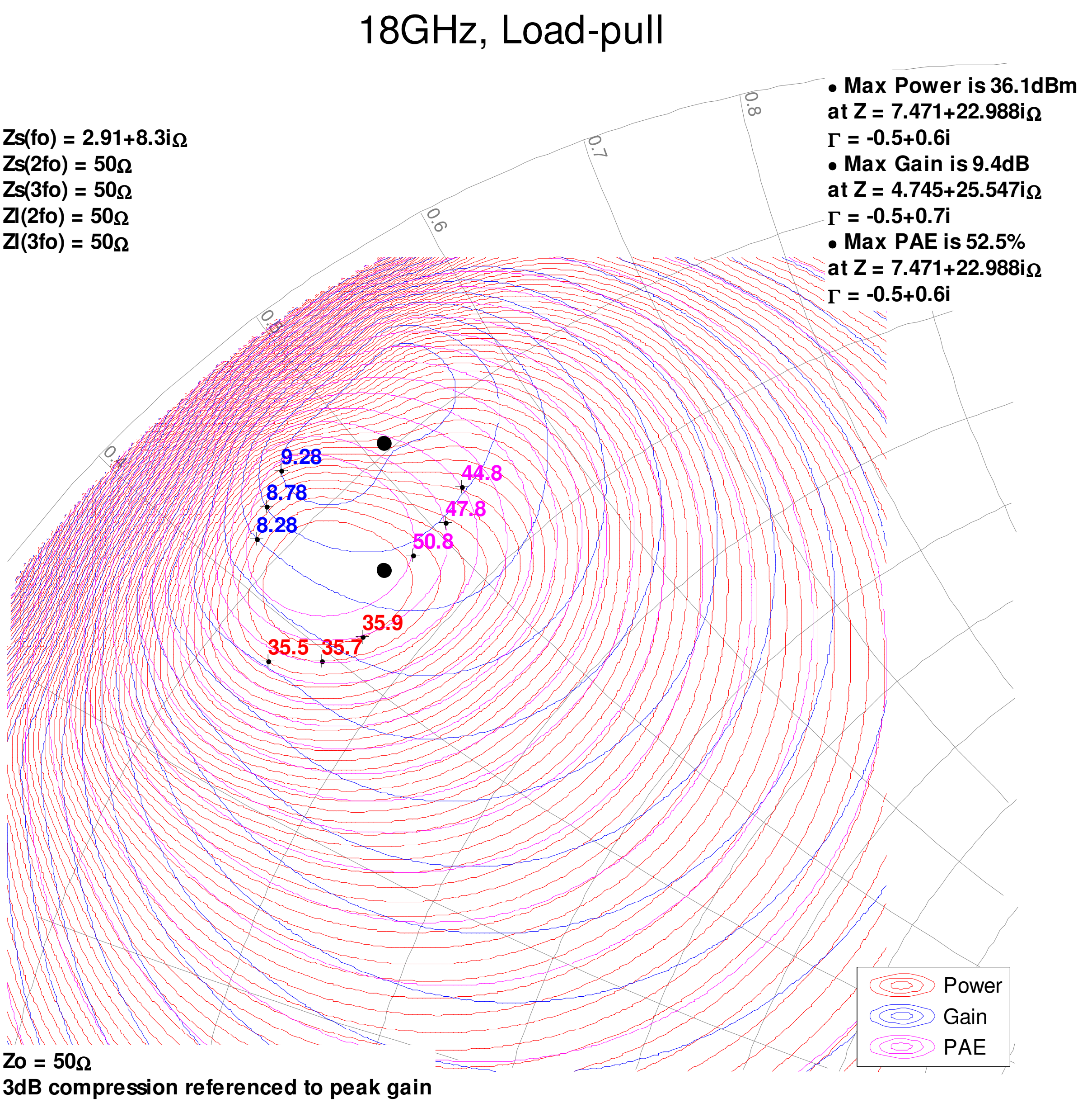
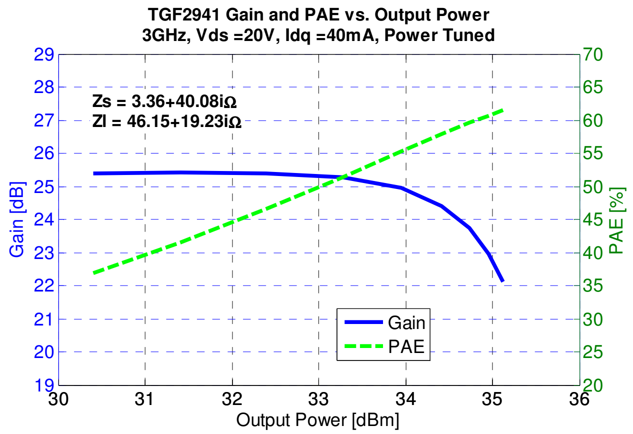
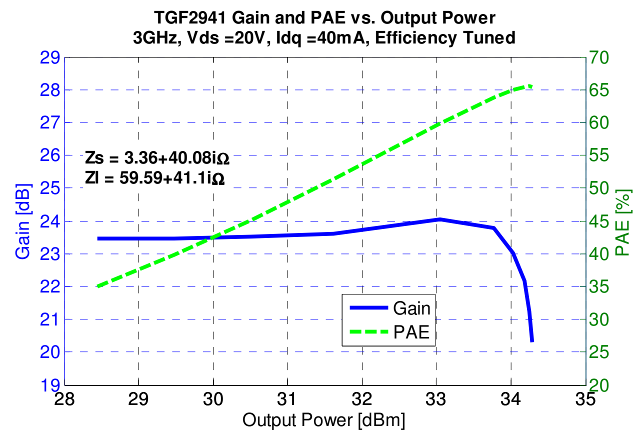
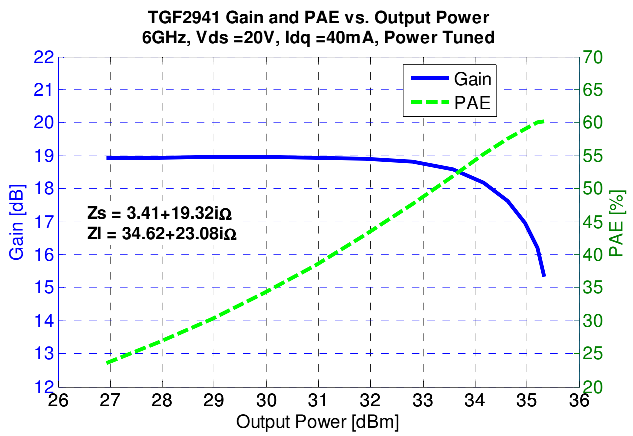


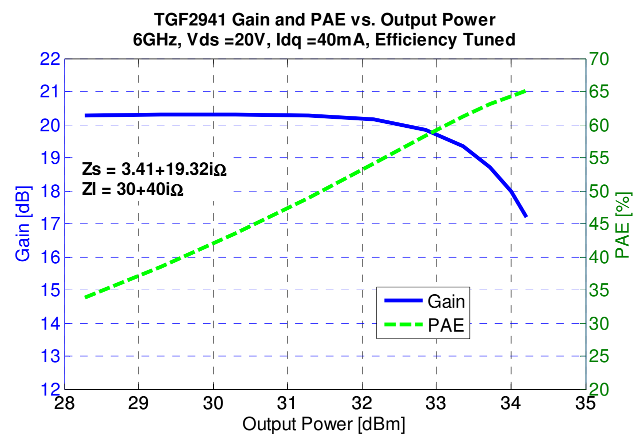
## Typical Model Performance – Load-Pull Drive-up[1, 2]

Notes:
1. CW, Bondwires not included
2. See page 22 for load-pull and source-pull reference planes where the performance was measured.



## Typical Model Performance – Load-Pull Drive-up[1, 2]

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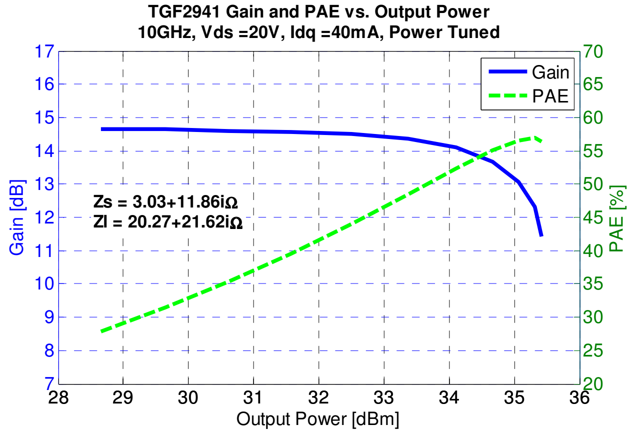
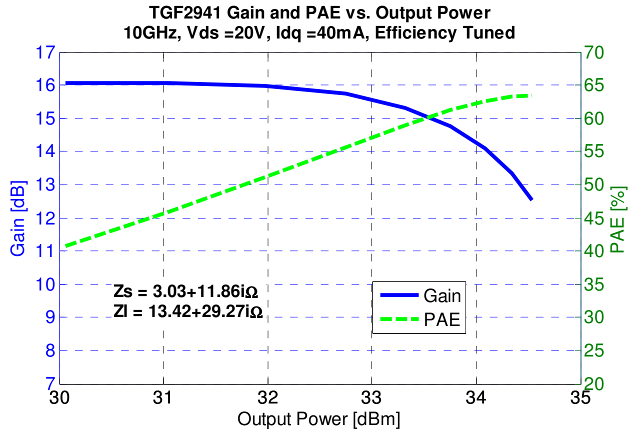
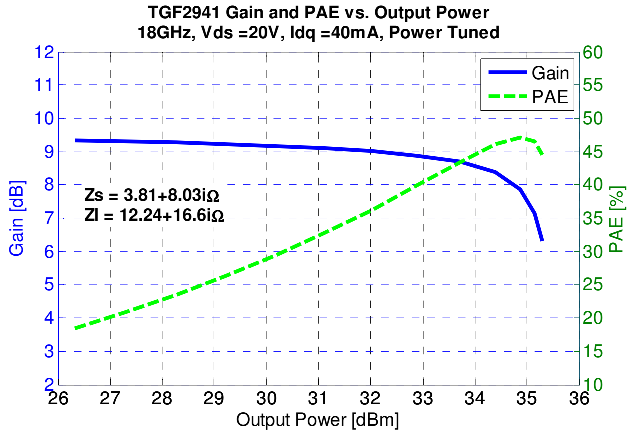
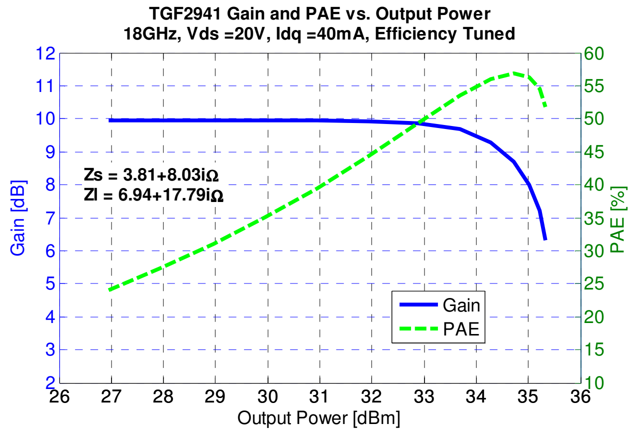


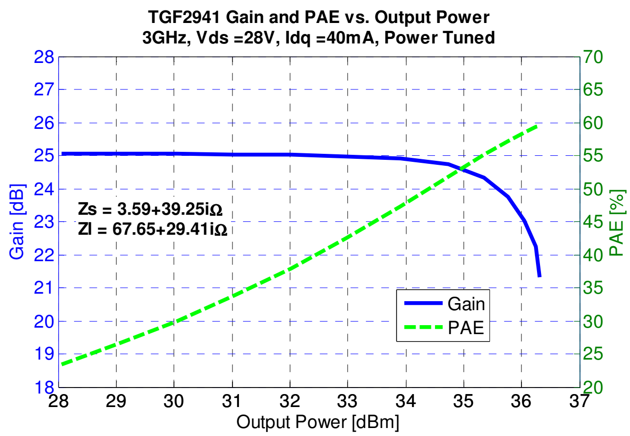



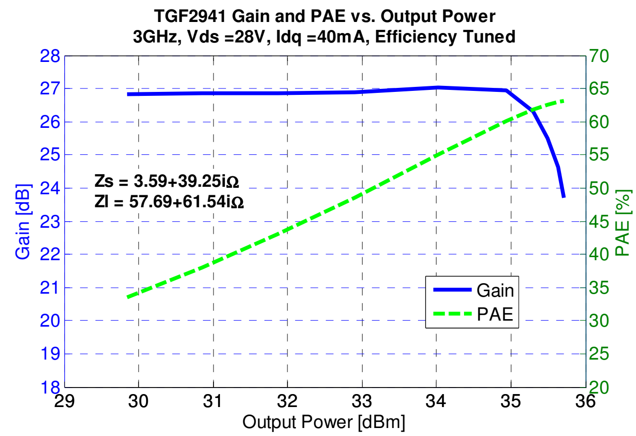



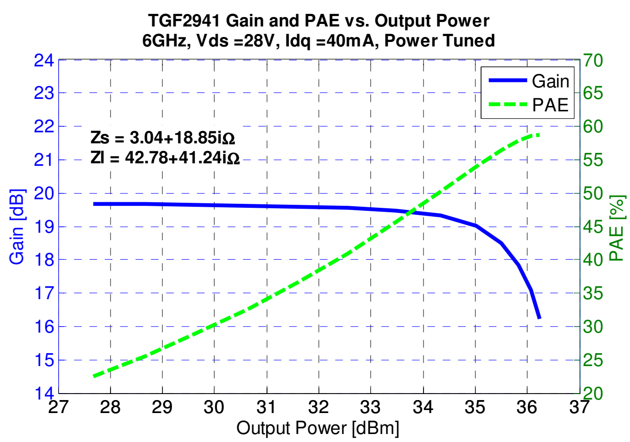



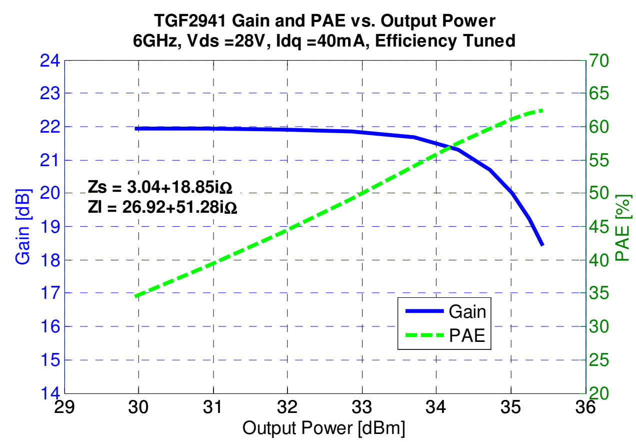
## Typical Model Performance – Load-Pull Drive-up[1, 2]

Notes:
1. CW, Bondwires not included
2. See page 22 for load-pull and source-pull reference planes where the performance was measured.



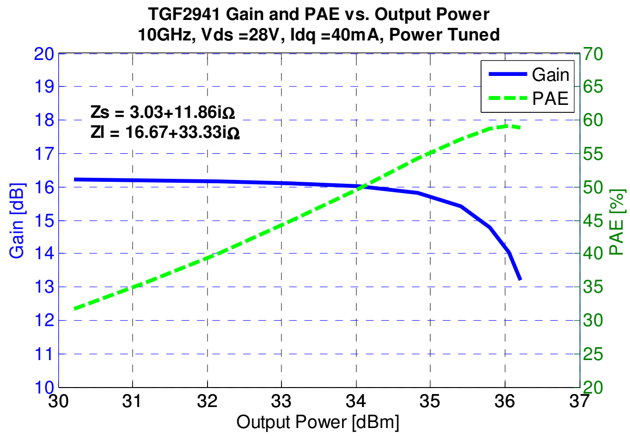



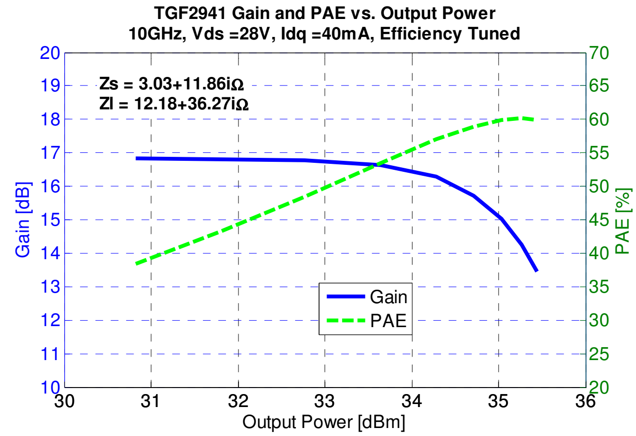



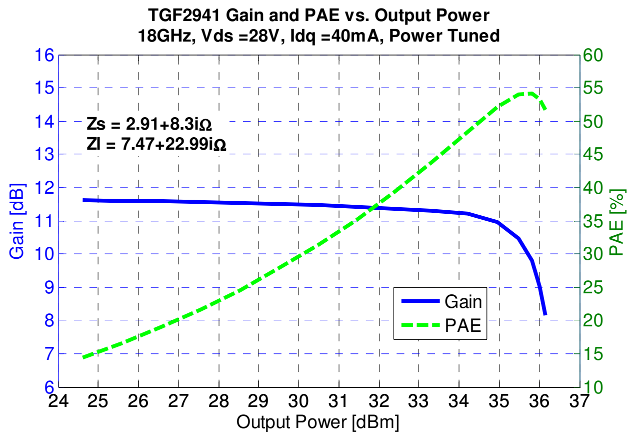



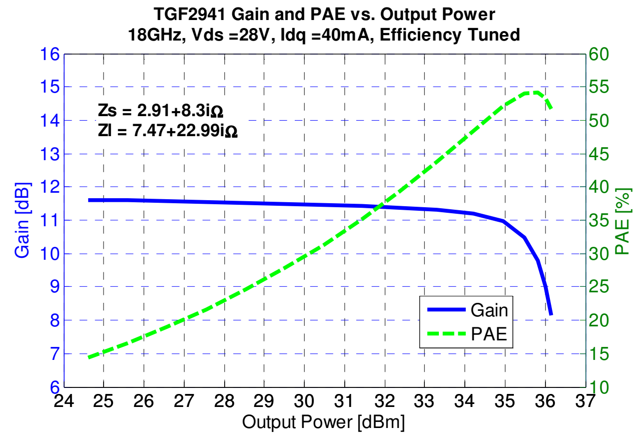
## Typical Model Performance – Load-Pull Drive-up[1, 2]

Notes:
1. CW, Bondwires not included
2. See page 22 for load-pull and source-pull reference planes where the performance was measured.

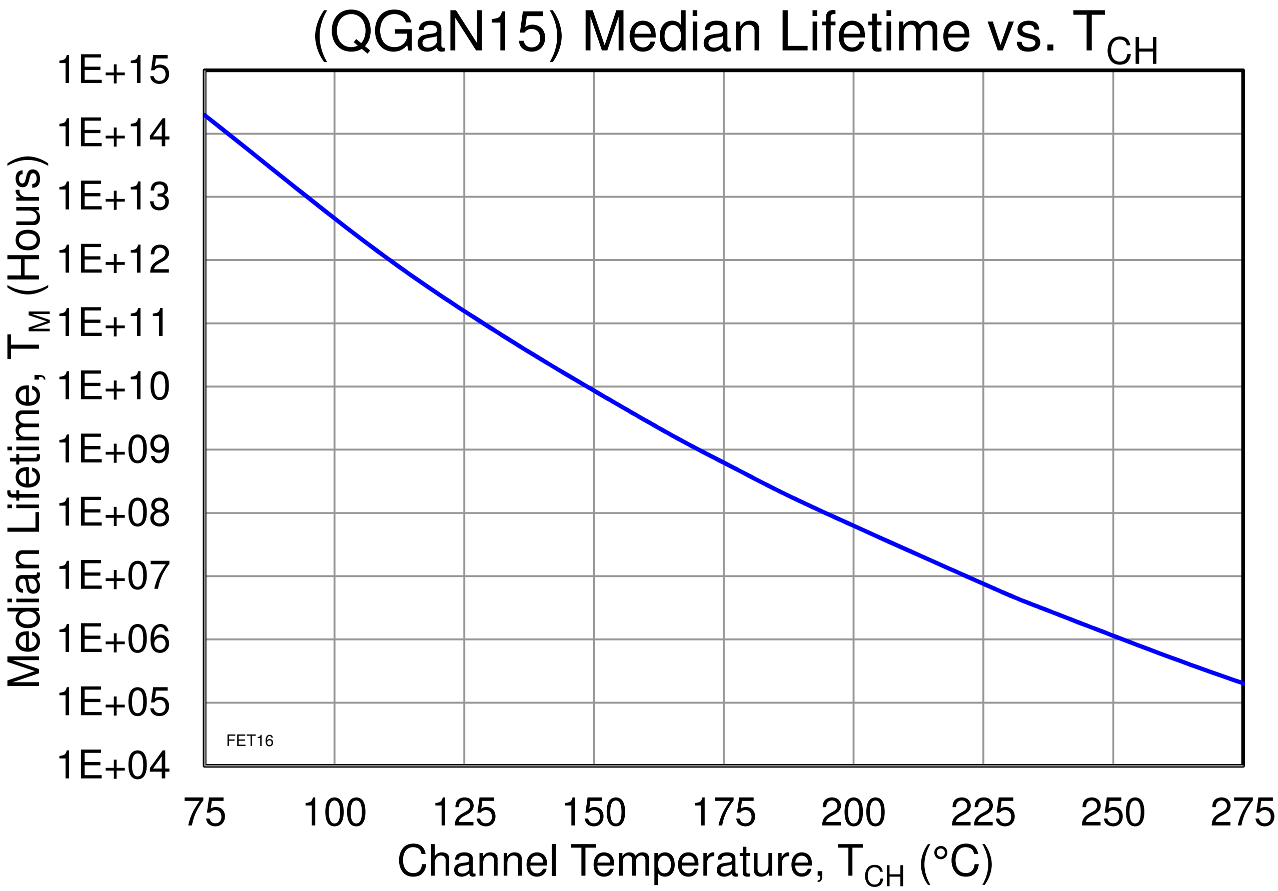


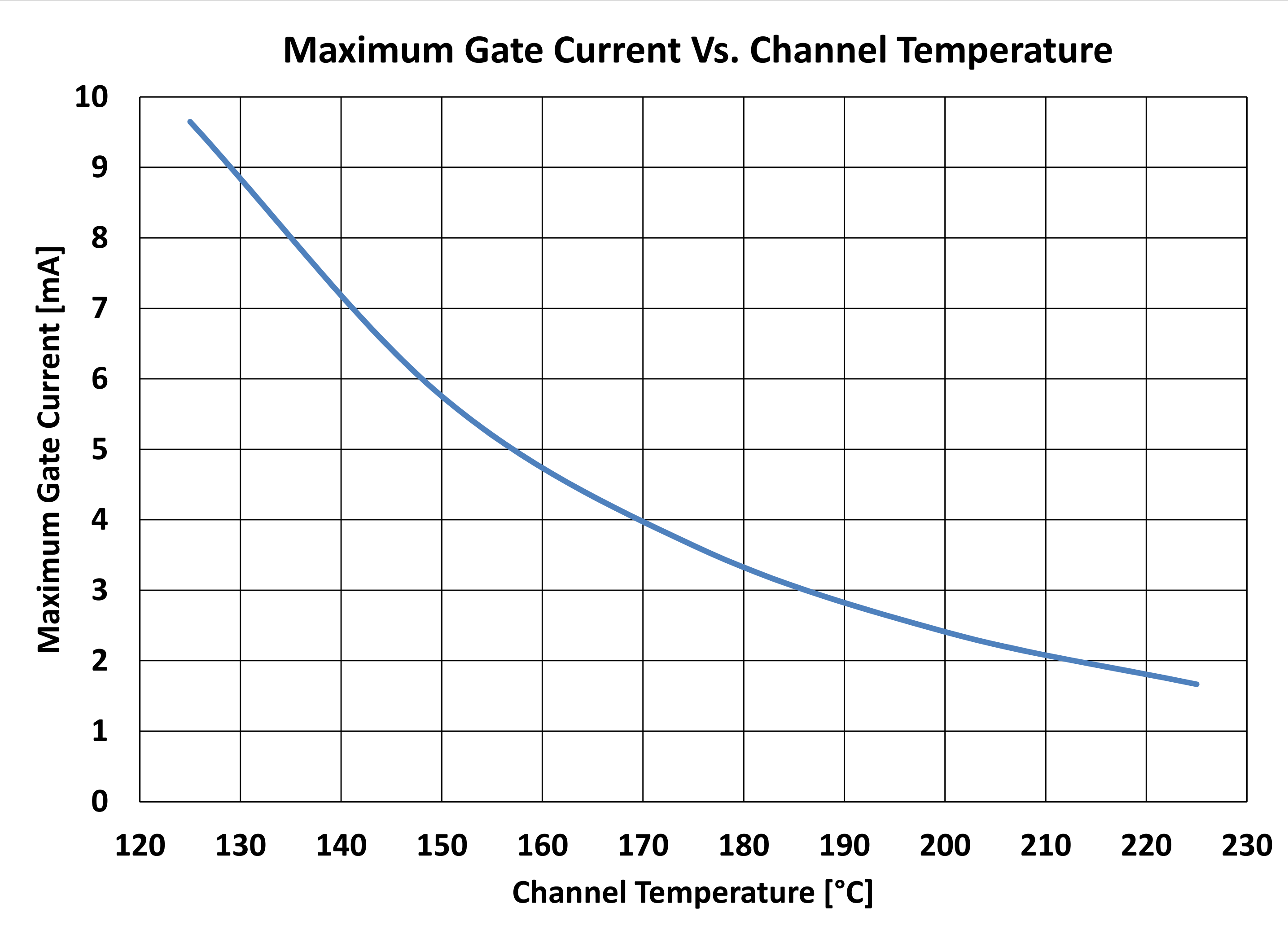



## Median Lifetime[1]




Notes:
1. Test Conditions: $V_D$ = +28 V; Failure Criteria = 10 % reduction in $I_{D\_MAX}$ during DC Life Testing

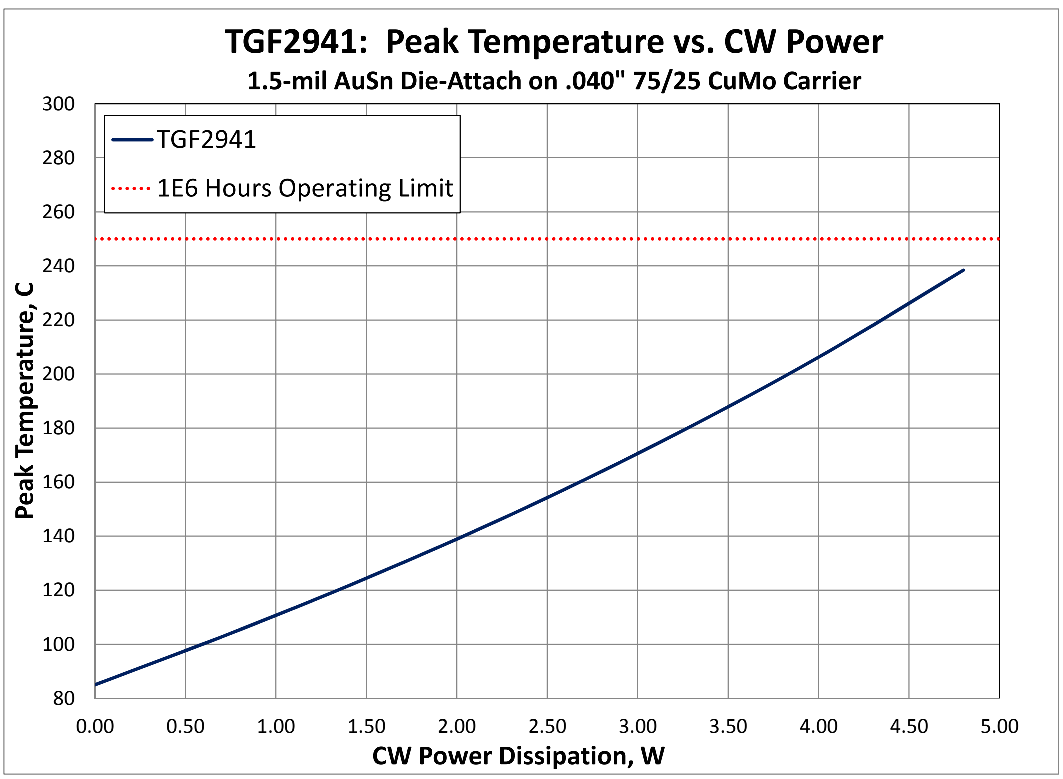
## Maximum Gate Current



## Thermal and Reliability Information

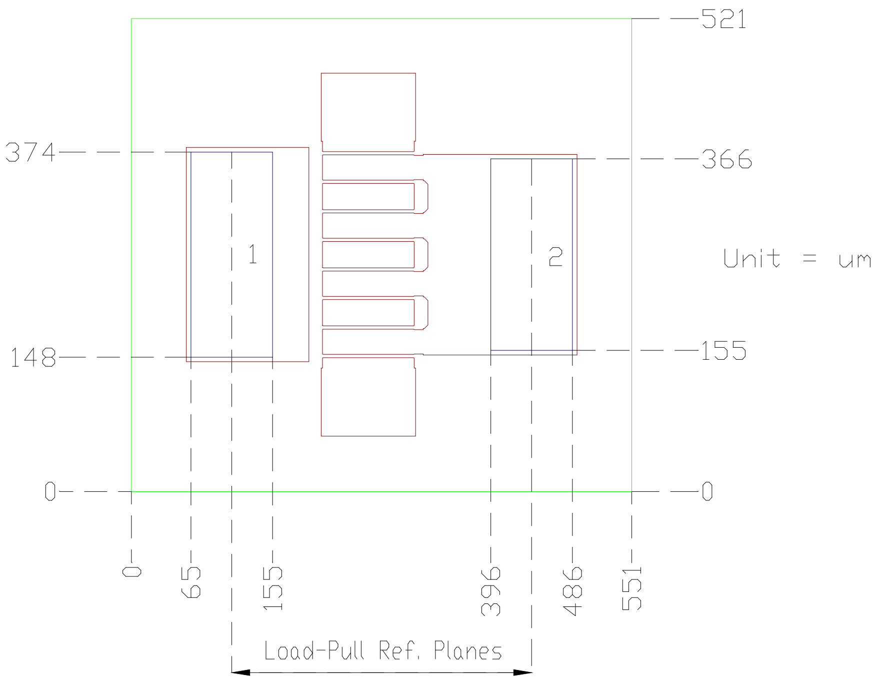
| Parameter | Test Conditions | Value | Units |
|---|---|---|---|
| Thermal Resistance, $\theta_{JC}$ (1) | CW<br>$T_{baseplate}$ = +85 °C<br>$P_{DISS}$ = 0.8 W | 25 | °C/W |
| Channel Temperature, $T_{CH}$ | | 105 | °C |
| Median Lifetime, $T_M$ | | 1.1E15 | Hrs |
| Thermal Resistance, $\theta_{JC}$ (1) | CW<br>$T_{baseplate}$ = +85 °C<br>$P_{DISS}$ = 1.6 W | 26.3 | °C/W |
| Channel Temperature, $T_{CH}$ | | 127 | °C |
| Median Lifetime, $T_M$ | | 2.7E13 | Hrs |
| Thermal Resistance, $\theta_{JC}$ (1) | CW<br>$T_{baseplate}$ = +85 °C<br>$P_{DISS}$ = 2.4 W | 27.5 | °C/W |
| Channel Temperature, $T_{CH}$ | | 151 | °C |
| Median Lifetime, $T_M$ | | 7.5E11 | Hrs |
| Thermal Resistance, $\theta_{JC}$ (1) | CW<br>$T_{baseplate}$ = +85 °C<br>$P_{DISS}$ = 3.2 W | 28.8 | °C/W |
| Channel Temperature, $T_{CH}$ | | 177 | °C |
| Median Lifetime, $T_M$ | | 2.4E10 | Hrs |
| Thermal Resistance, $\theta_{JC}$ (1) | CW<br>$T_{baseplate}$ = +85 °C<br>$P_{DISS}$ = 4 W | 30.3 | °C/W |
| Channel Temperature, $T_{CH}$ | | 206 | °C |
| Median Lifetime, $T_M$ | | 8.1E8 | Hrs |
| Thermal Resistance, $\theta_{JC}$ (1) | CW<br>$T_{baseplate}$ = +85 °C<br>$P_{DISS}$ = 4.8 W | 31.9 | °C/W |
| Channel Temperature, $T_{CH}$ | | 238 | °C |
| Median Lifetime, $T_M$ | | 2.7E7 | Hrs |

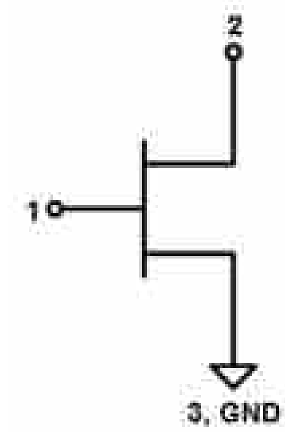
Notes:
1. Thermal resistance measured at back of package.



## Die Mechanical Drawing and Pin Description[1]

Notes: 1. Die size tolerance is ± 0.015 mm.




## Pin Description

| Pin | Symbol | Description | Dimension |
|---|---|---|---|
| 1 | RF IN / $V_G$ | Gate | 0.226 x 0.090 mm |
| 2 | RF OUT / $V_D$ | Drain | 0.211 x 0.090 mm |
| 3 | Source | Source / Ground / Backside of die | 0.521 x 0.551 mm |

## Assembly Notes

Component placement and adhesive attachment assembly notes:

- Vacuum pencils and/or vacuum collets are the preferred method of pick up.
- Air bridges must be avoided during placement.
- The force impact is critical during auto placement.
- Organic attachment (i.e. epoxy) not recommended.

Reflow process assembly notes:

- Use AuSn (80/20) solder and limit exposure to temperatures above 300°C to 3-4 minutes, maximum.
- An alloy station or conveyor furnace with reducing atmosphere should be used.
- Do not use any kind of flux.
- Coefficient of thermal expansion matching is critical for long-term reliability.
- Devices must be stored in a dry nitrogen atmosphere.

Interconnect process assembly notes:

- Ball bonding is the preferred interconnect technique, except where noted on the assembly diagram.
- Force, time, and ultrasonics are critical bonding parameters.
- Aluminum wire should not be used.
- Devices with small pad sizes should be bonded with 0.0007-inch wire.

## Disclaimer

GaN/SiC devices are susceptible to damage from Electrostatic Discharge. Proper precautions should be observed during handling, assembly and test.

| Bias-up Procedure | Bias-down Procedure |
| --- | --- |
| 1. Set $V_G$ to -4 V.<br>2. Set $I_D$ limit to 50 mA.<br>3. Slowly adjust $V_G$ until $I_D$ reaches 40 mA.<br>4. Set $I_D$ limit to 300 mA.<br>5. Apply RF signal. | 1. Turn off RF signal.<br>2. Turn off $V_D$ and wait 1 second to allow drain capacitor discharge.<br>3. Turn of $V_G$. |

## Handling Precautions

| Parameter | Rating | Standard |
|---|---|---|
| ESD – Human Body Model (HBM) | N/A | ESDA / JEDEC JS-001-2012 |
| ESD – Charged Device Model (CDM) | N/A | JEDEC JESD22-C101F |
| MSL – Moisture Sensitivity Level | N/A | IPC/JEDEC J-STD-020 |

Caution!
ESD-Sensitive Device

## Solderability

Compatible with both lead-free (260 °C max. reflow temp.) and tin/lead (245 °C max. reflow temp.) soldering processes.
Solder profiles available upon request.

Contact plating: NiPdAu

## RoHS Compliance

This part is compliant with 2011/65/EU RoHS directive (Restrictions on the Use of Certain Hazardous Substances in Electrical and Electronic Equipment) as amended by Directive 2015/863/EU.

This product also has the following attributes:

- Lead Free
- Halogen Free (Chlorine, Bromine)
- Antimony Free
- TBBP-A ($C_{15}H_{12}Br_4O_2$) Free
- PFOS Free
- SVHC Free

## Contact Information

For the latest specifications, additional product information, worldwide sales and distribution locations, and information about Qorvo:

**Web:** www.Qorvo.com **Tel:** +1.972.994.8465
**Email:** info-sales@qorvo.com **Fax:** +1.972.994.8504

For technical questions and application information: **Email:** info-products@qorvo.com

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